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Fraud Hexagon Theory" Evaluation Framework In Procurement: A Systematic Literature Review

Sofia Dewi[1*]
Universitas Lampung, Lampung, Indonesia[1*]
sofiadewi.pttk@gmail.com [1*]

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Abstract
Purpose: This study aims to identify and analyze the main causes of fraud in the public sector procurement process using the Hexagon Fraud Theory approach, which includes six psychological elements: opportunity, collusion, capability, pressure, ego, and rationalization.
Methodology/approach: The method used was A systematic literature review of 177 articles retrieved from the Scopus database between the range of 2019-2023. After selection based on certain criteria, 20 articles were analyzed thematically and classified into six categories based on the hexagonal fraud theory.
Results/findings: The results showed that Opportunity (50%) and collusion (25.93%) were the main causes of fraud in public procurement. Other factors included capability (9.26%), pressure (7.4%), ego (5.56%), and rationalization (1.85%).
Conclusions: Fraud in public procurement is mostly triggered by internal system weaknesses, collusion between internal and external parties, and a lack of transparency and accountability.
Limitations: This study was limited to a literature review and did not include direct empirical data in the field. In addition, the scope of the articles analyzed was mostly from developing countries, so the results cannot be generalized globally.
Contribution: This research provides a theoretical contribution by mapping the factors that cause fraud based on the Fraud Hexagon theory, as well as a practical contribution in the form of a proposed digital e-procurement framework that can be used as a reference in developing a more transparent, accountable, and anti-corruption procurement system.

Keywords: *Fraud Hexagon, Procurement.*

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1. Introduction

Public procurement is the process of purchasing or procuring goods and services in the form of construction or non-construction carried out by the public sector by collaborating with third-party companies. This procurement process allows the government to enter into work contracts with companies to carry out procurement activities on behalf of the government (Owusu, Chan, & Hosseini, 2020). Based on data from the Organisation for Economic Cooperation and Development (OECD) in 2021, public spending on procurement was 11 trillion dollars, or 12% of the global gross domestic product. (Bosio, Hayman, & Dubosse, 2023) and it turns out that public procurement is the most corrupt government activity (Alsamarraie & Ghazali, 2023).

Based on law enforcement data released by the Organisation for Economic Cooperation and Development, it shows that of the 427 cases of foreign bribery, the majority of cases, or 57%, involved bribes for public procurement contracts. Corruption in procurement is caused by a lack of accountability, conflicts of interest, and managerial incompetence (Graycar, 2019), an inadequate

internal control system, decentralised public expenditure data managed locally, and not being monitored in real time (Mircea, Stoica, & Ghilic-Micu, 2022). Another problem is that there is the insertion of specifications that restrict companies from competing, causing damage to fair competition due to collusion between civil servants and several companies. This practice significantly reduces the number of participants, thereby leading to higher prices and the supply of low-quality products. (Lima, Lira, Paiva, Silva, & Silva, 2023). Even though the dynamics of fraud problems in procurement are different, the motives for fraud are not free from psychological reasons, which are often ignored by the government. Georgios L. Vousinas from the National Technical University of Athens, Athens, Greece, developed the triangle fraud theory proposed, the diamond fraud theory proposed, and the fraud pentagon theory proposed by adding the element of "collusion" to the theory of fraud so that there are six psychological factors that cause fraud, consisting of stimulus, capability, collusion, opportunity, rationalisation, and ego.

Study researchers try to explore the problem of fraud that occurs in the public procurement process, which is connected to psychological reasons from the hexagon fraud theory, as a form of research innovation. This analysis was carried out by systematically reviewing literature originating from a collection of articles throughout the world from the reputable journal scopus.com. This analysis will answer the following three research questions: 1. What are the most frequent problems in procurement? 2. How do you solve this problem? And 3. What are the potential future research questions to explore?

2. Literature Review

Fraud theories have evolved to explain the complex motivations and conditions that drive fraudulent behavior in various organizational settings. The Fraud Hexagon Theory expands on earlier models by introducing six key elements—pressure, opportunity, rationalization, capability, arrogance, and collusion—that together provide a more comprehensive lens for understanding fraud. In procurement, these dimensions intersect uniquely because procurement processes often involve multiple stakeholders and high-value transactions, increasing the exposure to fraud risks. Understanding each of these components is crucial for developing a holistic fraud risk management strategy (Sukmadilaga, Winarningsih, Handayani, Herianti, & Ghani, 2022).

Procurement fraud typically occurs when individuals or entities exploit vulnerabilities in the procurement process to gain unfair advantage. Theories of fraud emphasize the role of organizational weaknesses, such as inadequate internal controls and oversight, which create opportunities for fraudulent behavior. The Fraud Hexagon Theory adds depth to this by highlighting the psychological and situational factors that enable such misconduct. By analyzing procurement fraud through this multidimensional framework, organizations can identify critical risk points and design more targeted interventions (Rendon & Rendon, 2016).

Technological advancements have introduced both challenges and opportunities in combating procurement fraud. While digital procurement systems can enhance transparency and traceability, they also present new avenues for sophisticated fraud schemes. The Fraud Hexagon Theory's framework is particularly useful in assessing how capability and opportunity interact in technologically mediated environments. A thorough evaluation of technological controls and vulnerabilities is vital in ensuring that procurement processes remain secure and fraud-resistant (Akushie & Yornu, 2024).

Finally, regulatory and compliance frameworks are key external factors that influence the risk of procurement fraud. Legal standards and enforcement mechanisms play a crucial role in deterring fraudulent activities, and their effectiveness can be analyzed using the Fraud Hexagon framework. By integrating regulatory perspectives into fraud risk assessments, organizations can better align their internal policies with external requirements, enhancing overall fraud resilience (Rustiarini, Nurkholis, & Andayani, 2019).

3. Methodology

3.1 Search and Data Retrieval

The first step is to determine the database that will be used. Researchers use scopus.com as a search data source. The keywords used are "procurement and fraud" from 2019 to 2023. *The year 2019 was used as the beginning of the extraordinary event of the widespread COVID-19 outbreak, which greatly affected global economic conditions, including its impact on the procurement of goods and services in the public sector. From this combination of searches, it has collected 177* articles from journals, proceedings, conferences, symposia, books, working papers, theses, and quotations.

3.2 Selection of Articles

The selection of articles is presented in the PRISMA flow diagram, after which the initial stage of article selection is carried out by limiting keywords to public procurement" or "fraud" or "corruption" or "crime" or "procurement" or "fraud detection" with the publication type "final" and limited to the document type "article," which is sourced from "journal" and usess "English."After limiting these criteria, 46 articles were obtained, which would be subjected to theme analysis.

3.3 Choose Theme

The articles that have been selected are then screened based on a predetermined theme, namely fraud in the procurement of goods and services, especially in the government sector, which is examined through the abstract and content of the article as a whole. After carrying out a more detailed theme screening process and downloading the full article, 20 articles remain to be analysed.

This literature identification process is also described in an inflow diagram adapted from.

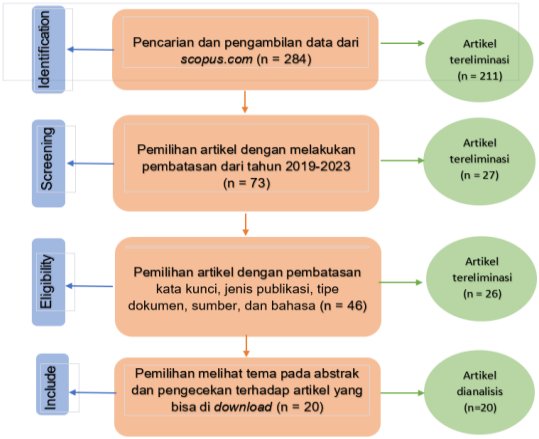

Figure 1. Article Selection Process

Based on the article screening that has been carried out, the articles that can be downloaded in their entirety are mapped based on the title, journal name, publisher, ranking on the Scopus database, which can be checked at scimagojr.com, and the themes raised in the research and research results can be explained as follows:

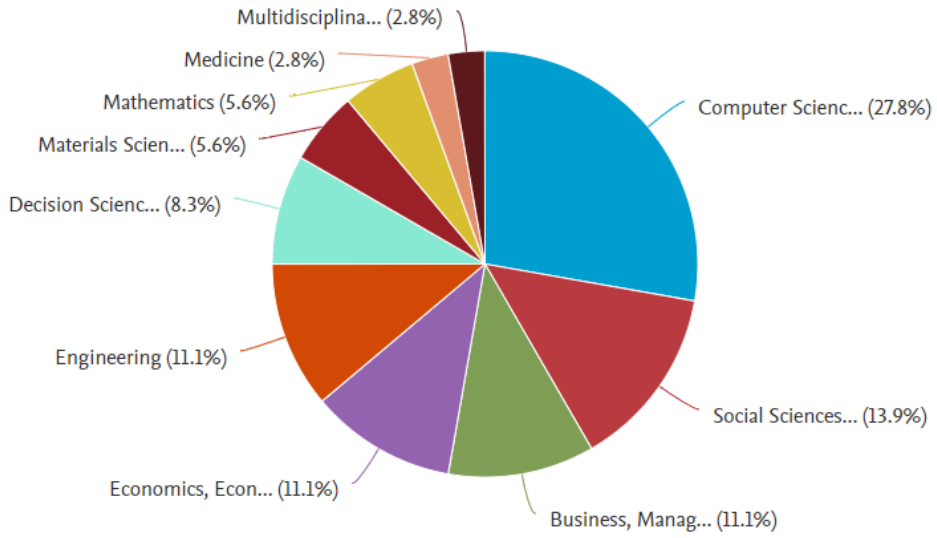

Figure 2. Articles based on subject area

Concluded that the area that discusses fraud in the procurement process more is the area of computer science. This is because most of the research provides solutions in the form of the latest technology for dealing with fraud in public procurement. For example, Mircea et al. (2022) discovered the relationship between blockchain and the Internet of Things (BIoT) with corruption and fraud, sustainability, transparency, trust, and national and international society. Then there are those who form a standard concept for an integrative procurement process in order to resolve the problem of fraud in public procurement (Alsamarraie & Ghazali, 2023). There is also research that analyses machine learning methods with various different algorithms to prevent procurement fraud (Nai, Sulis, & Meo, 2022). Apart from that, the Procurement Analytics Core Engine (PACE) application is also an example of technology created to reduce fraud in the public procurement process (Westerski et al., 2021). The successful combination of operations research methods (such as mathematical modelling, graph theory, and network analysis) with data science tools (such as data mining, clustering algorithms, anomaly detection, and risk ranking) is also a finding in combating fraud in the public procurement process (Velasco, Carpanese, Interian, Paulo Neto, & Ribeiro, 2021). So this finding supports research that found that one way to reduce inefficiency and abuse in public procurement is through the use of e-government procurement (e-GP) platforms (Bosio et al., 2023) because e-procurement has an influence on transparency and accountability and can fight corruption simultaneously.

E-procurement has the ability to ensure that inventory management runs effectively, has an accountable audit service trail, and minimises direct human contact in bidding (Aduwo et al., 2020). Then, with the proliferation of e-procurement systems in the public sector, anti-corruption agencies and watchdog organisations have access to a valuable source of information to identify suspicious transactions. (Gallego, Rivero, & Martínez, 2021). In fact, several studies specifically examine the type of e-procurement digitization framework, namely a blockchain-based framework developed to enable interoperability of information systems involved in the procurement process, thereby increasing community participation in generating project requirements and enabling more transparent project audit monitorin (Akaba, Norta, Udokwu, & Draheim, 2020). Apart from blockchain, there is also a model that determines other effective factors that influence corruption mitigation, namely the soft computing fuzzy logic algorithm, which provides a local semantic language structure to translate qualitative knowledge about the problem to be solved (Shareef, 2022). Then another model is data on bidding companies participating in the auction using the Korea Online E-Procurement System (KONEPS) to reduce corruption channels for entertainment costs in public procurement in Korea (Kang, Kim, & Kim, 2023). Although there are also results that doubt whether information and computer technology can effectively reduce fraud and do not have a measurable effect (Kim, Kim, & Lee, 2009), In fact, this information technology actually creates new opportunities for corruption and facilitates it (Darusalam, Janssen, Sohag, Omar, & Said, 2021).

We look at the country of origin that is the object of the research, developing countries are in the top three positions that conduct research on fraud in the public procurement process, namely Brazil, Indonesia, and Malaysia (Osita, Chukwuemeka-Onuzulike, Olayinka, & Onyeizugbe, 2024). This is because there are still many cases of corruption in developing countries, and corrupt behaviour in developing countries is dominated by public sector actors.

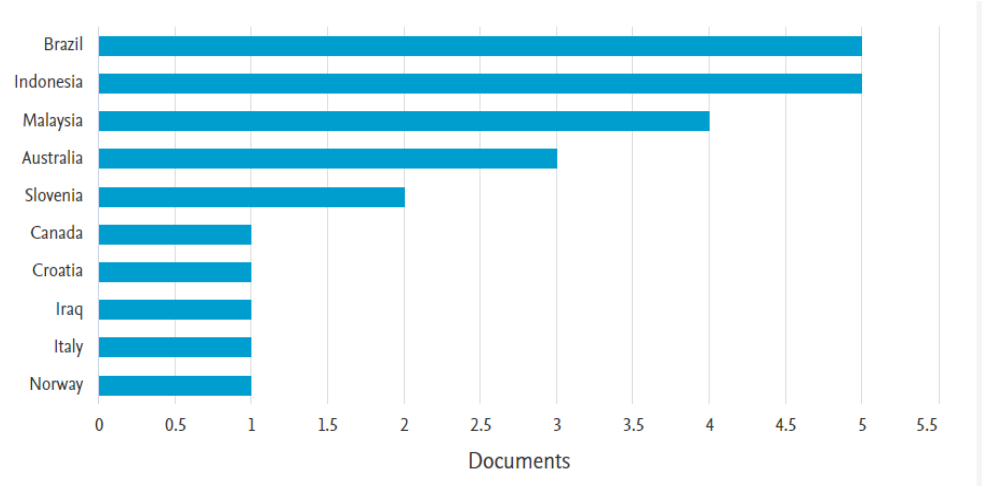

Figure 3. Articles based on country objects

Next, the researcher analysed the public procurement problems that appeared in each article into the S.C.C.O.R.E. model, or what is known as the hexagon fraud model which consists of pressure, capability, collusion, opportunity, arrogance, and rationalization. This aims to build the latest procurement framework model in order to prevent fraud during the process. The following is a systematic literature review analysis:

Table 1. Analysis of Problems Categorized in the Hexagon Fraud Model

No	***Authors***	**Problem**	**Hexagon Fraud Theory Category Analysis**	**Analysis of Results**
1	(Alsamarraie & Ghazali, 2023)	Lack of commitment management	Opportunity	Explains the improvement of the concept of procurement standards through the integrative procurement stage (IPS) through a systematic literature review
		Lack of transparency	Opportunity	
		Accountability matters	Opportunity	
		Lack of skills and knowledge	Capability	
		Inadequate government support	Opportunity	
		Resistance to change	Ego	
		Lack of planning	Opportunity	
2	(Johari et al., 2023)	Pre-contract stage tender collusion	Collusion	Validating the diamond fraud theory, with a questionnaire
		Fake invoice after contract	Capability	
		Lack of expertise and awareness of the law	Opportunity	
3	(Lima et al., 2023)	Collusion between employees and vendor companies	Collusion	Through experiments, researchers built an

		Higher prices with lower quality products	Collusion	application model to find signs of fraud in the procurement process
		Limiting competition	Ego	
4	(Signor et al., 2022)	Bid rigging or collusion	Collusion	Proving with experiments that game theory can help solve the problem of collusion in procurement using game theory
5	(Soylu et al., 2022)	there are significant deficiencies in the quality of published data	Opportunity	By analyzing secondary data through technology, this research recommends guidelines for managing and publishing public procurement data in accordance with open data principles to increase the availability and quality of published data.
6	(Hamza et al., 2022)	Non-transparent procurement tender system	Opportunity	Through questionnaires, researchers can conceptualize the procurement of goods and services so that it is more modernized
		Weak work capacity of procurement management employees	Opportunity	
		Weak control system	Opportunity	
7	(Lyra et al., 2022)	Limited objective indicators to measure risk	Opportunity	Not specifically examining the public sector but predominantly the private sector using a systematic literature review
8	(Nai et al., 2022)	Favoritism	Collusion	Explains that e-procurement is a tool used to prevent corruption with a systematic literature review
		Pricing that is too high	Pressure	
		Bribery	Collusion	
9	(Mircea et al., 2022)	No public control	Chance	Proving that Blockchain and the Internet of Think have a positive impact on corruption/fraud, sustainability, transparency and trust, national and international communities by distributing questionnaires
		There is no data-based policy and budget control	Chance	
		Special treatment	Collusion	
		False information	Capability	
		Bribery	Collusion	
10	(Zahra et al., 2021)	Slow payments	Pressure	Proving that e-purchasing can reduce collusion by opening market access, using questionnaires
		Specifications unclear	Opportunity	
		Bidding process is long and expensive	Ego	
		The concern is that the tender price must be low	Pressure	

11	(Westerski et al., 2021)	Vendors and requesters work together to seek profits at the expense of the organization	Collusion	Proving with experiments that with the platform they can control the effectiveness and efficiency of procurement operational activities
12	(Modrušan et al., 2021)	Collusion between vendors and employees	Collusion	Ranking and handling procurement risks with a systematic literature review using item response theory
		Collusion between vendors	Collusion	
13	(Zahra et al., 2021)	Lack of market access	Opportunity	Proving that e-purchasing can reduce collusion by opening market access, using questionnaires using the theory of planned behavior
14	(Velasco et al., 2021)	Inadequate internal controls	Opportunity	With experiments, researchers use a combination of operations research methods (mathematical modeling, graphic analysis and network analysis) to detect risks in public procurement
		A decentralized, locally managed collection of accountability data	Opportunity	
		Not monitored in real time	Opportunity	
15	(Mohd & Nohuddin, 2021)	Fraudulent coalition or tender rigging	Collusion	Through experiments the researchers proposed the incorporation of association rule techniques, which is an effective algorithm used to improve performance called PFCAF (Procurement Fraud Coalition Analytic Framework)
16	(Owusu et al., 2020)	Afraid	Pressure	Through distributing questionnaires to construction procurement implementers, information was obtained that socio-political barriers to construction are the most critical structures and have a strong impact on administrative, compliance and anti-corruption actions.
		Insecurity	Pressure	
		Administrative barriers	Pressure	
17	(Mackey & Cuomo, 2020)	process fraud	Opportunity	With a systematic literature review, researchers prove that e-procurement can be used
		Collusion	Collusion	
		Bribery	Collusion	
		Cartelism	Opportunity	

		Overpayment	RaOpportunity,	as a strategy to increase transparency, reduce costs, and prevent corruption in procurement but requires case study research to measure success and failure in the real world.
		Fake invoice	Capability	
18	(Rustiarini et al., 2019)	Pressure	Pressure	With experiments and qualitative explanations, researchers prove that pressure, opportunity, rationalization and capability are determinants of fraud in the procurement process in Indonesia using triangle fraud theory or cognitive dissonance theory.
		Opportunity	Opportunity	
		Rationalization	Rationalization	
19	(Rustiarini et al., 2019)	Capability	Capability	
20	(Graycar, 2019)	Coworking culture	Pressure	Through a systematic literature review, a classification of procurement types and activities along with prevention mechanisms was developed
		Lack of due process	Opportunity	
		Temptation	Ego	
		Managerial incompetence	Opportunity	

(Source: Data processed by Sofia Dewi, 2023)

The problem mapping above produces a red flag on public procurement, which can explain how problems occur in the process of procuring goods and services that have been carried out in various parts of the world, and each research project builds a conceptual framework to answer these problems (Chen, Chen, & Leung, 2023).

4. Result

Based on the table above, it can be concluded that the most fraud occurs due to the many opportunities in the public procurement process and the wide openings for collusion, and each element of the hexagon of fraud can be described by the red flag as follows:

Table 2. Results of Fraud Hexagon Element Analysis

Element	Redflag
Opportunity	Lack of commitment management, Lack of transparency, Accountability problems, Inadequate government support, Lack of planning, Lack of expertise and awareness of the law, there are significant deficiencies in the quality of published data, Non-transparent procurement tender system, Weak work capacity of procurement management employees, Weak control system, Limited objective indicators to measure risk, No public control, No data-based policies and budget control, Unclear specifications, Lack of market access, Inadequate internal controls, Decentralized and locally managed accountability data sets, Not monitored in real time, process fraud, Excess payments, weak internal control system, Lack of legal process, Managerial incompetence, Administrative obstacles, Slow payments, Pricing that is too high.

Collusion	Pre-contract stage tender collusion, collusion between employees and vendor companies, higher prices with lower quality products, tender collusion or collusion, Favoritism, Bribery, Preferential Treatment, Bribery, Vendors and applicants work together to seek profits at the expense of the organization Collusion between vendors and employees, Collusion between vendors, Fraudulent coalition or bid rigging, Bribery, Setting prices too high.
Capability	Lack of skills and knowledge, Fake invoices after contract, False information, Fake invoices, Intellectual capacity.
Pressure	Concerns that the tender price must be low, Insecurity, Obedience to superiors, Colleague culture
Ego	Resistance to change, Limiting competition, Long and expensive bidding process
Rationalization	Moral justification

As many as 50% of fraud problems in public procurement stem from opportunities in the public procurement administration process, then 25.93% of fraud problems are due to collusion between vendors and government employees, then 9.26% of fraud problems are caused by capabilities, amounting to 7 .4% due to pressure from internal and external parties, 5.56% due to arrogance or ego from office holders and 1.85% due to rationalization from the perpetrators of fraud. As shown in the following graph:

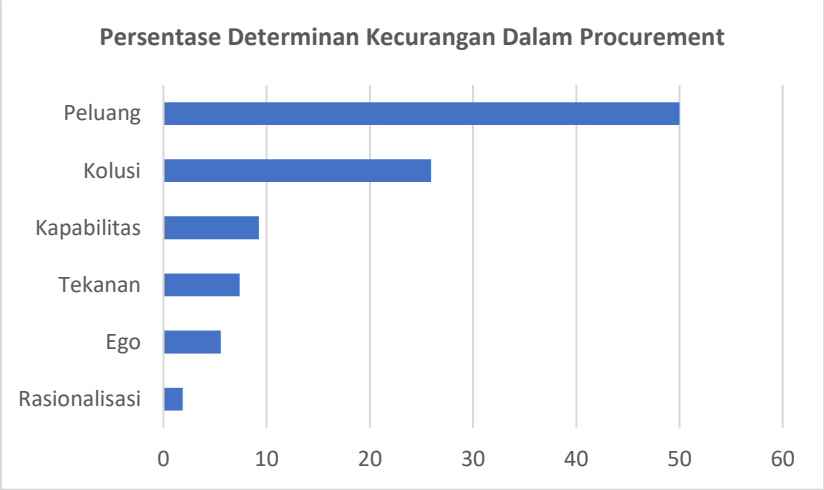

Figure 4. Percentage of Determinants of Fraud in Procurement

Opportunities can arise due to weak internal supervision and ineffective control monitoring, as well as assets that are vulnerable to fraud (Otonne & Ige, 2023). This theory is in line with the problems researched by academics, and after carrying out the analysis, this opportunity is formed due to lack of transparency, accountability problems, inadequate government support, lack of planning and commitment, lack of awareness of laws, lack of published data, weak work capacity employees, weak control system, limited objective indicators to measure risk, no public control, no data-based policies and budget control, unclear specifications, lack of market access, decentralised data, not monitoring in real time, lack of legal processes, and managerial incompetence (Osita et al., 2024). Meanwhile, rationalisation refers to justifying someone who commits fraud. Most people, including fraudsters, act honestly. Fraudsters often interpret themselves as victims of a sporadic environment and develop justifications that make their illegal behaviour acceptable (Seneviratne & Dharmasena, 2023). Meanwhile, pressure can be defined as concerns that the tender price must be low, fear, insecurity, and pressure from superiors. For capability, the problem is categorised as the ability to provide false information and create fake invoices. Arrogant behaviour also categorises problems into resistance to change and limits competition. However, the element of collusion, which is the newest element of hexagon fraud, is the easiest to find in cases of fraudulent procurement of goods because of collusion

between employees and third parties (Kuncara, 2022). So the role of relevant information technology is needed to overcome the determinants of this fraud. Researchers propose a new digital procurement system called "new e-procurement" to be used to inhibit or detect fraud problems early on so that the procurement process is more honest and has integrity, as illustrated below:

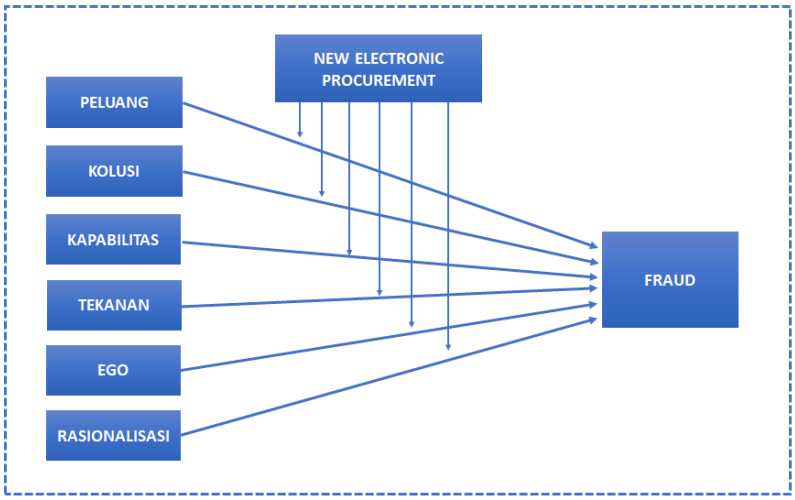

Figure 5. Proposed Framework

Based on the conclusion analysis above, potential future research to explore is how to build a digitalization system for procurement of goods and services that has an early warning system in order to prevent the occurrence of fraud determinants consisting of opportunity, collusion, capability, pressure, ego, and rationalisation (Agbo & Egbunike, 2024).

5. Conclusions

This study critically examines fraud in the procurement of goods and services within the public sector using the Hexagon Fraud Theory framework, which encompasses six interconnected elements: opportunity, collusion, capability, pressure, ego, and rationalization. Drawing from a systematic review of 20 peer-reviewed articles indexed in the Scopus database, the research identifies “opportunity” as the most dominant contributing factor to procurement fraud (50%). This is largely attributed to institutional weaknesses, including ineffective internal controls, insufficient transparency, poor accountability mechanisms, and weak oversight. The second most influential factor is “collusion” (25.93%), where fraudulent alliances between public officials and vendors emerge as a persistent pattern, undermining the integrity of the procurement process. “Capability” (9.26%) also plays a significant role, referring to the technical ability of perpetrators to exploit systemic loopholes through falsified documentation or data manipulation. “Pressure” (7.4%) and “ego” (5.56%) reflect internal and psychological motivations, such as financial strain or a sense of superiority, while “rationalization” (1.85%) highlights the cognitive justification of unethical behavior.

Technological innovations such as e-procurement platforms, blockchain integration, and machine learning algorithms are recognized as promising tools to mitigate fraud by enhancing transparency, traceability, and real-time auditing. Nevertheless, the deployment of such technologies must be accompanied by robust safeguards to prevent new forms of digital manipulation. Therefore, this study proposes a digital procurement model incorporating an early warning system tailored to detect anomalies across all six fraud elements. Future research should prioritize the contextual adaptation of this model in developing countries, where systemic corruption and institutional fragility present ongoing risks to procurement integrity.

Limitatation and Future Study

This study acknowledges several important limitations. First, the analysis is based solely on a systematic literature review using articles retrieved from the Scopus database, which, while academically rigorous, restricts the study's scope to secondary data. The absence of empirical field data means that contextual nuances and real-world complexities of fraud practices in procurement may not be fully captured. Second, a significant portion of the literature examined pertains to developing countries, potentially limiting the generalizability of findings to a global context—particularly to developed economies where regulatory frameworks and procurement technologies may differ substantially. Third, while the study highlights emerging technologies such as e-procurement, blockchain, and machine learning, these are discussed at a conceptual level without empirical validation or pilot implementation, which limits the practical applicability of the proposed solutions. Furthermore, the Hexagon Fraud Theory, although a comprehensive framework, has not yet undergone extensive quantitative testing to validate its predictive power or inter-variable relationships.

For future research, it is imperative to conduct empirical case studies in public institutions to examine the practical manifestations of the six fraud dimensions in real procurement processes. Researchers are encouraged to integrate advanced quantitative methods—such as Structural Equation Modeling (SEM) or logistic regression—to test the causal relationships among fraud factors. Comparative cross-country studies would also help assess the contextual relevance of fraud risk variables. Additionally, future studies should explore the integration of blockchain-based e-procurement platforms equipped with early warning detection systems and analyze their real-world effectiveness. Investigating the role of organizational ethics, internal audit systems, and whistleblower protections will further enhance the development of a robust, multifactorial fraud prevention model.

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